

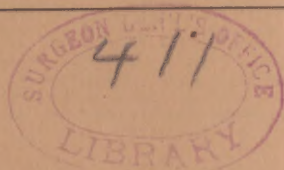
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Physiological Basis of
Objective Teaching,

BY

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LATE PROFESSOR OF PHYSIOLOGY AND
MICROSCOPIC ANATOMY IN THE
UNIVERSITY OF VERMONT.



The articles here found were originally written during a discussion in the local newspapers concerning past and present methods of teaching in our public schools. The suggestion that they be put in more convenient form for reading and distribution is hereby complied with.

MARSHALL CALKINS, A. M., M. D.

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PHYSIOLOGICAL BASIS OF OBJECTIVE TEACHING.

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As a parent who has himself been educated on the old plan, *i. e.*, of learning names without being taught the things which these are designed to represent; when the school committee could not afford a blackboard because it was an innovation and not an improvement; when the multiplication table was learned by united school repetition, when a square or cube was not in the school room, but a ferrule and birch stick were ever ready for the hands and backs of the disobedient and stupid; when all were compelled to learn definitions and rules without knowing what the objects were which they described; when long columns of words in the spelling book were placed before puerile brains, to memorize, whose meaning many have never since learned, I desire to make a few suggestions relative to the so-called new departure.

Years ago, the above was an illustration of the way pursued in education. But scientific men and physiologists, by studying the nature of the child and the progress of growth of the human brain and the way the faculties work in acquiring knowledge, have found that the best and most successful and least dangerous method to be pursued in education, is that which nature directs. "*Ducit ipsa natura*"—"Nature herself leads" should be the

guide. The pursuit of this way is agreeable and captivating to the youthful mind. Going to school is no crucifixion; for the youth thirsts for and enjoys the proper and reasonable exercise of the mental faculties just as well as the play of the muscles. What pleasure the infant seems to take in development in a natural way of its budding powers and capacities. It passes its little hands over external objects, feels of them, looks sometimes with long, intense and steady gaze, notices odors, listens to sounds, takes in impressions, through all its senses, and their sum total gives the idea of the external object. One of the joys of parentage is the observance of the gradual and natural development of the human faculties. Every day finds some new witness that the little one is gathering in knowledge, through objective impressions of every kind, and how important it is for the child's future that the things placed before its infantile consciousness should be of the best character.

Under such conditions how is it possible for the child by simply hearing a word, or by spelling it or repeating it, except in association with the thing represented, to gain correct knowledge of external objects. But when the word and the thing go together in association, the memory holds both in perpetual amity. Specialists on memory teach us that the secret of a good memory is careful observation or the giving of close attention to external objects. Without this culture of the observing faculties no student, however much he may know of words and phrases disconnected with their objects, can be truly educated. To educate is to bring out into available activity and development the latent faculties of the brain and mind and bodily powers, and by consequence all the senses—the carriers of external impressions within.

Muscular development must be secured according to the laws of nutrition and waste of muscular tissue. The nervous system and the brain must be cultured on the same principle, and as the brain uses about one-sixth part of all the blood of the body, yet weighs only about one-fortieth of the entire bodily weight, its successful culture will be largely contingent upon the perfection of bodily health, digestion and respiration, etc. Hence, proper

food, cleanliness, ventilation, proper temperature and light are indispensable. And again the mental activity must also be determined in degree and duration by the periods of growth of the nervous system. The infant and very young child should not be taught in the same manner as during adolescence.

Physiologists have found that study physiologically adapted to different ages is healthful, and not exhausting, a pleasure, not a burden, as is a method of forcing mental activity beyond capacity. With adult students of good habits and constitutions eight or nine hours a day may be safely spent in mental work, while students in high schools, from 12 to 17 years of age should not be occupied in brain work more than six or eight hours; below 12, four hours is sufficient; below 10, three hours; below 7, two and a half hours. Children from 5 to 7 years of age can only attend to one subject or lesson for about fifteen minutes; from 7 to 10, about twenty minutes; from 10 to 12, twenty-five minutes; 12 to 18, thirty minutes at a time without danger to the brain. The reason is found in the incomplete growth of the brain in young persons.

We see in these physiological facts why children need frequent changes of position. Their powers of concentration are feeble. If too much or difficult work is demanded, nothing is gained in progress. The half-time system for children—three hours a day—in England has been found equally effective as the six-hour. If the youthful faculties are reasonably cultivated, in due proportion and without mental fret, the brain is easily laden with impressions, which the faculty called memory can utilize—but to cultivate or try to cultivate memory especially before the others have time for growth would be plainly contrary to nature's method. It is well known how much more quickly an American child in a foreign country learns the native language than an adult. But the child uses no effort, the memory is not strained, because all faculties are engaged in the work, as hearing, seeing, etc. Even the gestures of others, the handling of objects, the names of which are given by a playmate, are teachers. In fact the association of a word with a thing is the foundation of memory.

The best way to learn to write and speak a new language is to practice speaking and writing it, for the ear and muscles of speech and eyesight, all must be educated, as well as the memory. The best book students in a foreign language are unable either to speak or understand the foreign tongue. No amount of memorizing words unless these are used in relation to the knowledge of the objects they represent can be true education. In the teaching of geography, the drawing of continents, islands, rivers, mountains, educates muscles and nerves and gives ideas of form, proportion, size, while it cultivates memory by association.

But the object of the writer is not to make lengthy discussion of these matters which long since have been settled by experts. As a physician who has watched the course of study in our public schools for 35 years, I am sure the practice of pressing the memory more than other faculties of the mind is not the best way to educate. It leads not infrequently to utter disgust, on the part of the student, with his work, often produces nervous exhaustion, sometimes fatal diseases of the brain. Few physicians of careful observation fail to see these unfortunate and sad results, and many of the best physiologists and educators deplore them, and when a bright youth has been stricken down in the day of promise, the lesson taught is that we should be cautious how we put too much tension on that most delicate and wonderful instrument, —the tenement of the soul—the brain.

But I need not rest the case here. I fearlessly charge the old method with failure to accomplish what is possible under more scientific teaching. From the common school to the end of the university course in American institutions, except within a few years, or since the partial adoption of more physiological methods, the college graduates, whether in law, medicine or theology, have been compelled to go into the battle of life poorly equipped for the struggle. As an example we find the college graduate cannot enter upon the work of a Journalist without serving an apprenticeship in the use of good English. Brought to the test of practical work he finds himself deficient and discovers that learning is doing. The lawyer learns his profession in the court room. The

clergyman, after graduation, is forced to take lessons of the "uneducated" in order to become a successful fisher of men. The physician lays aside much of his theoretical learning and adopts the method of studying by objects. So it comes to pass that to succeed in their work the "educated" break away from learning from books only and seek to learn according to nature and her laws.

For the physiological way of studying, the American students go to Germany or other European countries, because they are better, more thorough and effective in their methods of teaching. For this our new universities are springing up after the models of the European, and foreign professors are often called here to aid in the work. The so-called new departure here is comparatively old in Germany, and is approved by the most learned and best thinkers of the age.

Guided by our more recent progressive leaders shall we in Massachusetts leave the work to be carried to completion in the New West and California where new ideas can have free course, or should we adopt it and thus obtain its benefits, and thereby continue to merit and hold our assumed pre-eminence in the work of education?

The brain being the seat of the intellectual faculties, first feels the effects of continuous mental application. If exercised more than its nutrition will permit, a condition results called cerebral exhaustion. This condition is most easily induced in children and young persons from over-strain of the mental faculties, and is often manifested in adults by inability to thoroughly apply the thoughts to a subject or problem, by loss of interest in business, by confusion of ideas, troubled dreams and disturbed sleep, by impaired digestion, headache, dizziness and great exhaustion from a small degree of mental effort. When these indications of brain trouble occur, nature points out the remedies, viz.: change, rest and sleep. With children mentally over-taxed at school we often observe ill temper, impatience, headache, weariness, palpitation of the heart, dull expression of the countenance, drooping eyelids, poor appetite, indigestion and emaciation.

Prof. Wm. Goodell, of the University of Pennsylvania, describes the effect of too much brain work on the school girl, as follows: "She enters the school in blooming health, and without an ache; is over-tasked and over-taxed; she loses her appetite, and grows pale and weak; she has cold feet and blue finger-nails, and complains of pains in the chest, headache and an oppressive sense of exhaustion distresses her. She is wearied beyond measure by the slightest mental or physical exertion; a grasshopper is a burden to her and she finally becomes hysterical. Unimproved she drags herself from one consulting room to another, until finally, in despair, she settles down to a sofa in a darkened room and lapses into hopeless invalidism. And what is the interpretation of this train of symptoms? The yet developing nerve centers of this *brain-crammed* girl, were unable to cope with the strain thrown on them, and they break down."

Prof. H. I. Bowditch remarks: "I have seen not a few patients,—scholars—who under the violent stimulus put upon them by an approaching exhibition or examination for rank or for prizes, have sunk immediately after such extra intellectual labor, wholly prostrated in mind and body."

These symptoms are a warning to the teacher, and signs which should be heeded by parents. Pupils so affected should lay aside book work and be sent into the country to recuperate. There, surrounded by natural objects, the study of vegetable and insect life with other kindred subjects may be pursued without detriment.

Several years since there came under the observation of the writer a prematurely developed child, that was a prodigy in memorizing rapidly, and was, therefore, brought forward as a *show* at school and church exhibitions. Warning of danger was given, but advice was not followed, and in a short time fatal inflammation of the brain resulted. A young girl, about the age of 15, preparing for examinations fell suddenly ill with convulsions and delirium, in which the school and its exercises were the themes of her wild imaginings, and her life was with great difficulty saved. Another, an only daughter, just passing on to graduation, had

fatal inflammation of the brain, and unrealized hopes agonized the heart of a loving parent. Another in the last year of her school work had nervous prostration, and for two years past has been under careful treatment, but continues to suffer from over brain work. Another ambitious to finish her college education early, and desirous to rank high, studied constantly and assiduously, until delusions clouded her mental faculties. As remedial agencies she received all the benefits of travel, and diversion, and every hygienic means that wealth could furnish, and yet after many months her complete recovery seems doubtful. Another lingers in an asylum for nervous invalids, the brain having given way under too excessive exercise. As I pass over these and similar cases in recollection, I find the most probable cause in the violation of the physiological laws of the human brain.

At birth, this organ for the most part is a kind of semi-fluid pulp or marrow, with a small portion somewhat hardened. The soft mass gradually becomes firmer; cells and fibers develop; partitions form to separate rooms for individual faculties. At from five to ten years of age the brain is still undeveloped, and in process of active growth.

Concerning the time that children are physically qualified for brain work, Dr. C. A. Hardy, of New York remarks: "I have reared seven full formed, healthy, hearty, intelligent children, have watched over the health of thousands of others, have taught many, and my conclusions are, that no child should be *forced* to take up a book until he is ten years old, or until his body is fully developed, and is strengthened for the coming strain upon his mind by plenty of exercise, good pure air and strong healthy food. I do not say that books should not be used by children before they have reached their tenth year, but I say that they should not be *forced* to study before that age."

The idea intended to be given in the above quotation, is not that children should have no means of education, before the age of ten years, but that this should be acquired according to objective methods, in obedience to which learning may be obtained without injury. Indeed, physiological exercise of the mental

faculties tends to strengthen and develop them. Laboratory work, or illustrative teaching, with young or old does not produce overstrain of the brain, and no cases of this kind are reported as the result. Indeed, the first conceptions of a subject with students of all ages, should be from objective methods, a truth recognized by educators of standing, even the most conservative.

Prof. T. M. Balliet thus remarks: "The steps by which the child's mind passes from the concrete to the abstract, and, consequently, the time for discontinuing the use of objects in teaching, can be determined only by the most careful investigation—an investigation that is the work of experts. No general principle, or rule, can be formulated, however, which the teacher can follow in a mechanical way. The mental growth and development of each child must be carefully watched and objective work be discontinued as soon as he has the power to clearly grasp abstract principles and generalizations."

The brain should not be too early taxed with abstract mental work not adapted to its capacity; for, like the muscles and other parts of the body, this organ continues to grow until from 25 to 30 years of age. In acquiring knowledge, the young person, especially, best learns the object and its properties and attributes together. The word orange gives no idea to the child comparable in value to that acquired by handling, seeing and tasting it; nor, should learning by the objective method be confined to the young. Through life, name, object and properties, can be profitably studied together in order to obtain the most complete and accurate knowledge. Traveling and pictorial illustrations are educational for all; hence their increasing use and popularity. Webster's Unabridged defines both by language and pictorial illustration. The illustrated magazine or newspaper is a physiological educator.

Worry, anxiety and rivalry are dangerous elements in school. The brain gives way most frequently in girls—less so in boys—under the strain of competitive examinations, and severe tasks of memorizing. The nervous systems of the latter are less sensitive, and their opportunities for out-door life and consequent

bodily development are greater and more often utilized. The principle of alternating rest with mental work, of balancing repair and waste, prevails in the bodily functions and should be dominant in educational methods. When sleep becomes irregular in pupils, disease of the cerebrum is imminent. Sleep is more important for the brain-worker than for the muscle-worker, for it furnishes the only full opportunity for the complete repair of the cerebral cells. If these are too much exercised a condition called "insomnia" or wakefulness arises which if long continued may end in the most serious consequences. Eight or nine hours a day for older students with additional hours for the younger should be appropriated for that purpose, and no interference be more than very occasionally allowed. "Burning the midnight oil" is as injurious as it is unphysiological, for sufficient sleep removes from the student and literary worker an active cause of disease. Gladstone is a good sleeper and his wonderful political and literary achievements show the salutary results. Of him who can yield to the natural demand for brain rest and repair, the lines of Armstrong are descriptive :

"He, not in vain,
Invokes the gentle deity of dreams,
His powers the most voluptuously dissolve
In soft repose. On him the balmy dews
Of sleep with double nutriment descend."

In conclusion, we perceive that over exercise of the brain causes a variety of morbid symptoms, both in the adult, and in the young, sometimes resulting in cerebral inflammation and mental derangement. That school work, especially with the young, when pursued by the abstract method, is often injurious, and unsuccessful, while studying by the investigation of objects is in accordance with physiological laws, and secures more satisfactory results; and lastly, that diversion, rest and sleep are necessary and successful means of repair for temporary over-work of the mental faculties.

